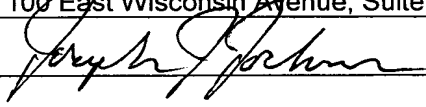
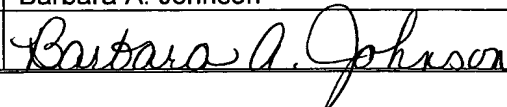


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0001/PTO Rev. 10/95	U.S. Department of Commerce Patent and Trademark Office	Application Number	10/806,589	
TRANSMITTAL FORM (to be used for all correspondence after initial filing)		Filing Date	03/23/2004	
		First Named Inventor	Robin D. Hill	
		Group Art Unit		
		Examiner Name		
Total Number of pages in this Submission		2+	Attorney Docket Number	2432-00015

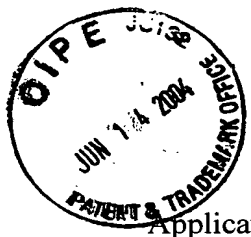
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT	
Firm Or Individual Name	JOSEPH J. JOCHMAN (Reg. No. 25,058) ANDRUS, SCEALES, STARKE & SAWALL, LLP 100 East Wisconsin Avenue, Suite 1100, Milwaukee, WI 53202
Signature	
Date	June 11, 2004

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			June 11, 2004
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Of:)
)
ROBIN D. HILL)
)
Application No.: 10/806,589)
)
Filed: 03/23/2004)
)
Group Art Unit:)
)
Examiner:)
)
FUSE ARRANGEMENT)

TRANSMISSION OF PRIORITY DOCUMENT

COMMISSIONER FOR PATENTS
P.O.. Box 1450
Alexandria, VA 22313-1450

Sir:


Enclosed is a certified copy of the priority document identified in the formal papers of this application as filed.

The claim for priority made in the formal papers is reiterated.

Acknowledgement of the receipt of this certified copy in the next Patent Office correspondence is respectfully requested.

Respectfully submitted,

ANDRUS, SCEALES, STARKE & SAWALL, LLP


Joseph J. Jochman
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Attorney Docket No: 2432-00015



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INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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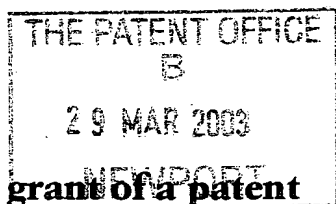
Signed

Dated 18 March 2004

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6-8-01

Patent Act 1977
(Rule 6)



SINAR03 E796368-1 D02282
P01/7700 0.00-0307306.1

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

RAB.P04786GB

2. Patent application number

(The Patent Office will fill in this part)

0307306.1

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Goodrich Control Systems Limited
c/o Ernst & Young
400 Capability Green
Luton
Bedfordshire LU1 3LU
Great Britain

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

8573582001
Great Britain

4. Title of the invention

Fuse Arrangement

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Marks & Clerk
27 Imperial Square
Cheltenham
Gloucestershire GL50 1RQ
Great Britain

Patents ADP number (if you know it)

18014 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application number (if you know it)	Date of filing (day / month / year)
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day / month / year)
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:


- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
- See note (4))

Yes

Patents Form 1/77

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Continuation sheets of this form

Description	7
Claim(s)	Nil
Abstract	Nil
Drawing(s)	2 + 2 

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Priority documents

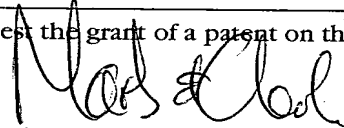
Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.
Signature  Date 28.03.03
Agents for the Applicants

12. Name and daytime telephone number of person to contact in the United Kingdom
Richard A. Bailey - 01242 524520

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After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

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FUSE ARRANGEMENT

This invention relates to a fuse arrangement, and in particular to a fuse arrangement suitable for incorporation on the surface of a circuit board.

Electronic engine controllers for aerospace applications typically take the form of complex, multi-layer circuit boards carrying a number of components. Due to the complexity and cost of these boards it is important to protect them from damage. One potential cause of damage to components carried by these boards is the application of transient high voltages to the input or output lines of the boards, for example as may occur in the event of a lightning strike. One technique for guarding against such damage is to provide suppressors which are designed to protect circuitry connected to the associated input or output line by clamping the line at a safe voltage in the event of the application of a transient high voltage, the excess current being conducted to ground. These devices can be provided upon a separate circuit board which can be replaced relatively cheaply in the event of damage.

Another potential cause of damage is due to short circuits occurring between circuits which, under normal operation, are unrelated. For example if a high voltage power supply line and a line connected to a low voltage sensor become shorted to one another it will be appreciated that there is a significant risk of damage to the associated engine controller. Although suppressors are used successfully to guard

against damage due to transient voltages, they are not suitable for preventing damage due to the application of continuous voltages as may occur in the event of a short circuit, and will typically fail resulting in the excess voltage being applied to a vulnerable circuit of the engine controller causing damage thereto. Once one circuit
5 has become damaged, there is a risk of damage propagating to other circuits, particularly on high density boards such as those used in electronic engine controllers.

It is known to provide a conventional fuse in series with a suppressor so that the fuse blows before the suppressor fails open circuit, under continuous short
10 circuit conditions. However, the use of such fuses is undesirable as they tend to be of large dimensions and hence are difficult to accommodate in areas of high track density, particularly adjacent the board's connectors. Further, many aerospace applications require the components used to operate at temperatures of up to 125°C. Most commercially available fuses cannot be used reliably as their current rating
15 falls to an unusably low value at elevated temperatures.

It is known to form a reduced thickness fuse portion in the conductive track provided on the surface of a circuit board. However, it has been found that, depending upon the circuit or track layout, the track may fail other than in the fuse portion upon the application of an excess voltage. This is undesirable since failure

may occur at positions which could cause shorts to other circuits or on tracks within the board which could cause a fire.

It is an object of the invention to provide a fuse arrangement in which the disadvantages mentioned hereinbefore are overcome or of reduced effect.

5 According to the present invention there is provided a fuse arrangement comprising a circuit board having a terminal region and a conductive track electrically connected to the terminal region, the conductive track including a fuse region of reduced cross-sectional area, the fuse region being shaped to cause a deviation in the current flow through the fuse region, and wherein the part of the
10 conductive track between the terminal and the fuse region is free from sharp deviations.

It has been found that the provision of the fuse region shaped to form such a deviation in the current flow results in the formation of a point of high current density which is likely to fail first in the event of the application of an excess
15 voltage, particularly if no sharp deviations to current flow are formed in the part of the track between the terminal and the fuse region.

The fuse region preferably comprises first and second parts which are angled to one another to form the deviation. Preferably the first and second parts are angled to one another by an angle of 70° to 110° , more preferably about 90° . It has been

found that such an arrangement is of good reliability.

The fuse arrangement may further comprise a clamping device electrically connected to the track. The clamping device may take the form of, for example, a suppressor, a zena diode or a ground link.

5 The invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a fuse arrangement in accordance with an embodiment of the invention;

Figure 2 to 4 illustrate modifications to the arrangement of Figure 1; and

10 Figures 5 and 6 illustrate further modifications.

The fuse arrangement illustrated in Figure 1 comprises a copper or other conductive material track 10 formed on the surface of a circuit board, the track 10 being electrically connected to a terminal 12 of any suitable form, and to the components of a circuit. The track 10 may also be connected to a clamping device, 15 for example in the form of a suppressor 26 (as shown in the modification illustrated in Figure 5), a zena diode, or a ground short 28 (as illustrated in the modification of Figure 6). As shown in Figure 1, the track 10 includes a region of reduced width, and hence reduced cross-sectional area, which will hereinafter be referred to as the fuse region 14. The fuse region 14 is connected to the terminal 12 by a portion 16

of the track 10 which is free from deviations. The fuse region 14 is shaped to form a significant deviation in the flow of current along the track 10. The deviation is formed by providing the fuse region 14 with a first part 18 and a second part 20 which are angled to one another to form therebetween a sharp deviation to the flow of current along the track 10. As the portion 16 is free of deviations, the deviation formed in the fuse region 14 is the closest deviation to the terminal 12.

It is thought that the provision of the sharp deviation in the direction of current flow results in the formation of a point 22 of high current density, and the formation of such a point acts as a failure point in the event of the application of an excess voltage to the track 10 at which failure will occur first. Once the material at the point 22 has become molten, the adjacent part of the track will rapidly melt causing a break in the track 10.

In the arrangement illustrated in Figure 1, the first and second parts 18, 20 of the fuse region 14 are angled to one another by an angle of 90° . It is thought that the use of such an angle is advantageous in that it provides an optimum balance between the formation of a point of high current density and minimises the amount of track material which must be deformed during rapid heating under overload conditions to cause the fuse to blow. Although it is thought that an angle of approximately 90° provides the optimum balance between these factors, it will be appreciated that

the invention is not restricted to the use of this angle, and that the invention covers the use of other arrangements using larger or smaller sharp deviations in the current flow through the fuse region, although they may operate less predictably. For example, the angle may fall within the range 70° to 110° .

5 Figures 2, 3 and 4 illustrate modifications to the arrangement shown in Figure 1. In the arrangement of Figure 2, the fuse region 14 is formed with a V-shaped indent 24 which forms a deviation in the flow of at least some of the current flowing along the track 10, again resulting in the formation of a point 22 of high current density. The arrangement of Figure 3 is similar to that of Figure 1, but the
10 first and second parts 18, 20 of the fuse region 14 are of reduced dimensions with the result that only part of the current flow along the fuse region 14 is deviated. Again, such an arrangement results in the formation of a point 22 of high current density. As the arrangements of Figures 2 and 3 do not form a deviation across the full width of the track 10, it is thought that the point of high current density will be
15 of lower concentration than that achieved in the arrangement of Figure 1.

The arrangement of Figure 4 is similar to that of Figure 1, but is suitable for use where the track 10 is made up of parts which are not aligned with one another. In this arrangement, as with that of Figure 1, the layout of the fuse region 14 is such as to form a significant deviation, thus the point 22 of high current density is well

defined.

Although the fuse arrangements described herein are suitable for use in aerospace applications, and in particular for use in protecting the circuits of an electronic engine controller, it will be appreciated that the fuse arrangements may
5 be used in a number of other applications.

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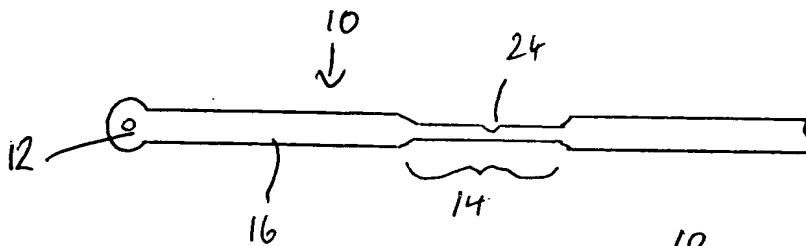
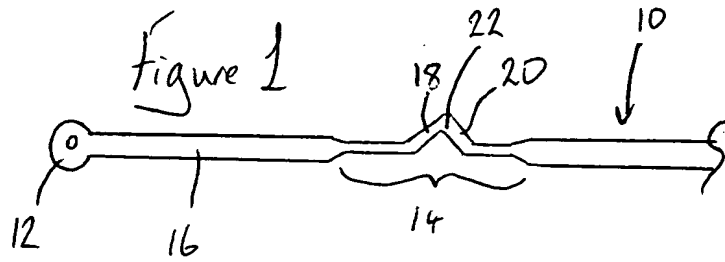


Figure 2

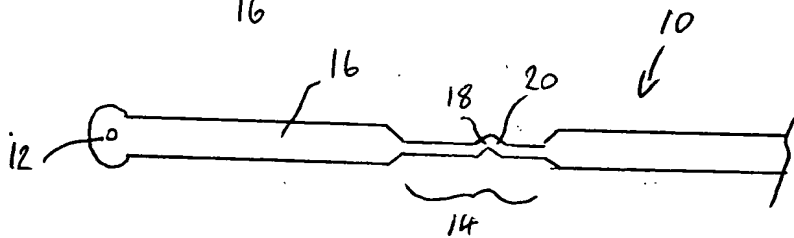
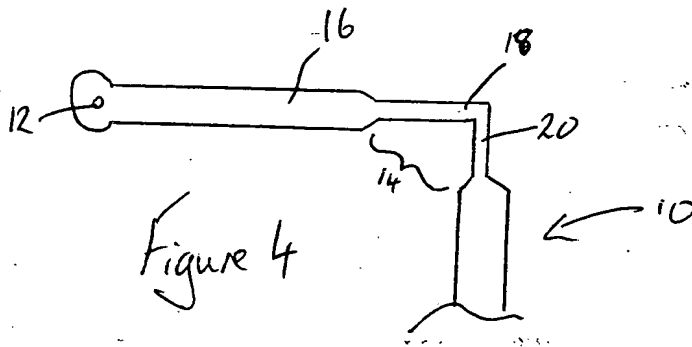


Figure 3



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Figure 5

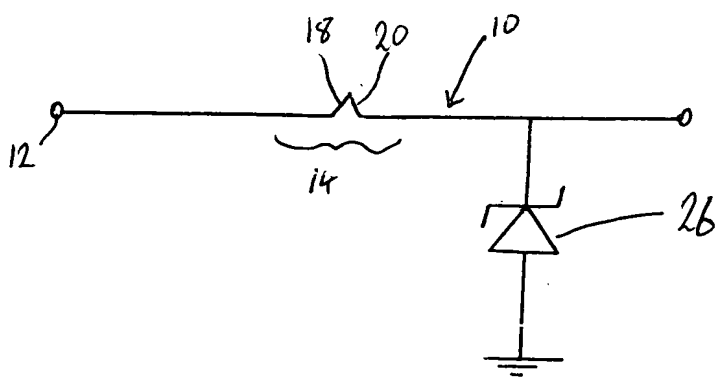
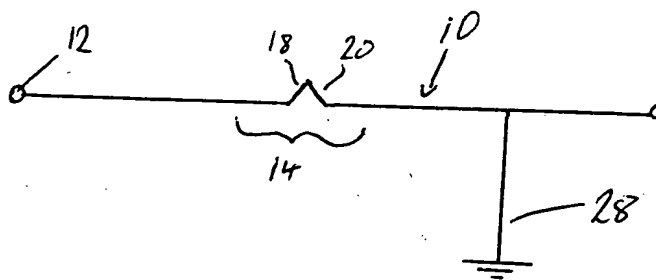


Figure 6



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